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MODULAR SIMULATOR SYSTEM (MSS)

SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM - FLIGHT STATION MODULE VOLUME 2

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AUGUST 1993

FINAL REPORT

SYSTEMS ENGINEERING DIVISION
AERONAUTICAL SYSTEMS CENTER
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This technical report has been reviewed and is approved for publication.

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13. ABSTRACT *(Maximum 200 words)*

This is the Flight Station portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the "Modular Simulator Engineering Guide" and the "Modular Simulator Management Guide" prior to tailoring this volume.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Contd.)

LIST OF FIGURES

PREFACE

This generic Modular Simulator System (MSS) segment specification has been developed in accordance with DI-CMAN-80008A; Data Item Description for System/Segment Specifications. This specification meets or exceeds the requirements for MIL-STD-490, Type A, specification. This specification is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. Training devices may consist of Weapons System Trainers (WST), Operational Flight Trainers (OFT), Cockpit Procedures Trainers (CPT), Part Task Trainers (PTT), etc.

Tailoring will be necessary to meet specific application requirements. The tailoring must be accomplished so as not to violate the goals and intent of the MSS concept. It is assumed that the user of this document has a familiarity with MSS design concepts and architecture, the application aircraft training requirements, and general working knowledge of aircraft training systems. It is suggested that the user read the "Modular Simulator System Engineering Design Guide" (D495-10440-1) and the "Modular Simulator System Management Guide" (D495-10439-1) prior to tailoring this specification. These guides provide an overview of the MSS architecture, an in-depth discussion on its application, and lessons learned from previous applications.

Each segment in the MSS architecture provides a portion of the overall system functionality. Similar functions and operations were grouped in each segment based on past experience, areas of design expertise, and management of intersegment communication. To promote reuse of the segments and gain the maximum benefits of using the MSS approach, it is suggested that the user adhere to the generic functional allocation. Interfaces between segments should remain relatively constant from application to application. The application vehicle is considered to be an air vehicle (e.g. fixed wing, variable geometry, or rotary wing.), although the MSS architecture and concepts may be applied to either ground or sea vehicles.

This specification contains specific tailoring instructions for each paragraph. The instructions are contained within the paragraphs, and are identified by blank spaces and/or italicized text. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. Paragraphs which do not apply to a particular application should not be deleted. They should be identified as "Not Applicable" to maintain paragraph numbering consistency between volumes and various MSS applications.

1. SCOPE

1.1 Identification. This segment specification establishes the requirements for the Flight Station segment of the _____*(insert application aircraft type)* Modular Simulator System (MSS). This volume is one of _____*(insert number of volumes in the application system/segment specification)* volumes which comprise the system/segment specification for the _____*(insert application aircraft type)* MSS. Volume I of this specification contains system level requirements such as MSS structure, communication architecture, network interface performance, system level diagnostic and test requirements, Ada programming language applicability, adaptability and expansibility, and other requirements which pertain to all volumes.

1.2 System Overview. The Flight Station segment provides for the simulation, stimulation, and/or emulation of the ownship ancillary systems and crew station interfaces for the _____*(insert application aircraft type)* MSS. The Flight Station segment provides for the simulation of the electrical system, hydraulic system, fuel management system, pneumatic system, oxygen system, autochecklist, and crew station interface functions throughout the flight envelope of the ownship. The Flight Station segment provides outputs to the crew compartment indicators and supplies the necessary data (electrical power, hydraulic power, fuel available, etc.) to support other segments. The Flight Station segment interfaces with the other MSS segments as described in the _____*(insert application aircraft)* Interface Design Document (IDD), _____*(insert IDD document number)*. Each of the Flight Station functions identified are processed within the Flight Station segment.

1.3 Document Overview. This segment specification defines Flight Station segment unique requirements for the _____*(insert application aircraft type)* MSS. It contains requirements for the functions performed within the segment including communication interface requirements, segment performance requirements, segment diagnostic and test requirements, and expansibility and adaptability requirements as applicable to the Flight Station segment.

2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The Government documents which are applicable to the entire _____*(insert application aircraft type)* MSS are listed in Volume I of this specification. The following Government documents are in addition to those documents and specifically applicable to the _____*(insert application aircraft type)* Flight Station segment.

SPECIFICATIONS:

Federal - *(Identify applicable federal specifications)*
Military - *(Identify applicable military specifications)*
Other Government Agency - *(Identify applicable government specifications)*

STANDARDS:

Federal - *(Identify applicable federal standards)*
Military - *(Identify applicable military standards)*
Other Government Agency - *(Identify applicable government standards)*

DRAWINGS: *(Identify applicable drawings)*

OTHER PUBLICATIONS:

Manuals - *(Identify applicable manuals)*
Regulations - *(Identify applicable regulations)*
Handbooks - *(Identify applicable handbooks)*
Bulletins - *(Identify applicable bulletins)*

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer.

(In this paragraph, list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents

referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The non-Government documents which are applicable to the entire _____*(insert application aircraft type)* MSS are listed in Volume I of the System/Segment Specification. The following non-Government documents are in addition to those documents and specifically applicable to the _____*(insert application aircraft type)* MSS Flight Station segment.

SPECIFICATIONS: *(Identify applicable non-government specifications)*
STANDARDS: *(Identify applicable non-government standards)*
DRAWINGS: *(Identify applicable non-government drawings)*
OTHER PUBLICATIONS: *(Identify applicable non-government publications)*

Technical Society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

(In this paragraph, list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

3. SEGMENT REQUIREMENTS

3.1 Segment Definition. The Flight Station segment is one of _____*(insert number of segments to be used in the application simulation)* unique segments which comprise the _____*(insert application aircraft type)* MSS. The Flight Station segment shall provide the modes, states, and functions as defined in this specification volume and Volume I.

The Flight Station segment shall provide the real-time simulation of the _____*(insert application aircraft type)* ancillary systems in normal and degraded operation. It shall also provide the crew station controls and instruments interfaces to the Input/Output (I/O) hardware devices.

(This paragraph should be tailored to convey the exact top level functions required of the segment. If this segment is to be used/reused on several devices within a family of trainers, that should be stated here with any unique performance requirements.)

3.2 Characteristics

3.2.1 Performance Characteristics. Performance of the Flight Station segment shall be as specified herein and in accordance with the _____*(insert application aircraft type)* design criteria. The Flight Station segment shall simulate functions associated with _____ *(insert application aircraft type)* MSS crew station controls and displays, and ancillary devices. The fidelity of the Flight Station segment shall be sufficient to provide the necessary level of training as specified in Volume I, paragraph 6 of this specification

(Additional text should be added to this paragraph to identify the design criteria and specific Flight Station components. A general statement with respect to the fidelity of the simulation should be added.)

3.2.1.1 Segment Modes and States. The Flight Station segment shall support the modes and states as described in Volume I of this specification. Additional requirements, or operations shall not cause degradation of the system nor violate the intent of the system level mode or state.

(Introduction of new modes is prohibited. Functions should be accomplished within the established modes and states. This paragraph should describe the segment's response to a given mode or state. Subparagraphs should be added to identify and define unique segment requirements for each mode and state.)

3.2.1.2 Flight Station Segment Functions. Functions characterized as "Implemented" shall be implemented to the extent described by the paragraphs dedicated to those functions. Functions characterized as "Not Applicable" shall not exist in this simulation of the _____*(insert application aircraft type)*, and are

not required to be implemented in any form within the Flight Station segment.

a.	Flight Station Support Function	Implemented
b.	Electrical System Function	*(Implemented, N/A)*
c.	Hydraulic System Function	*(Implemented, N/A)*
d.	Fuel Management System Function	*(Implemented, N/A)*
e.	Pneumatic System Function	*(Implemented, N/A)*
f.	Autochecklist Function	*(Implemented, N/A)*
g.	Oxygen System Function	*(Implemented, N/A)*
h.	Crew Station Interface Function	*(Implemented, N/A)*

(Each function listed should be characterized as "Implemented" or "Not Applicable (N/A)".)

3.2.1.2.1 Flight Station Support Function. The Flight Station support function shall provide the segment unique support services required for the operation of the Flight Station segment in the MSS environment. The Flight Station support function services shall include the functions listed below, and as described in the following paragraphs.

a. Executive Control
b. Initialization
c. MSS Virtual Network (VNET) Communication
d. Diagnostics and Test
e. Backdoor Interfacing
f. Malfunctions
g. Damage Assessment
h. Security Processing
i. Scoring
j. Other Support Function Services

(Service functions are usually incidental to the simulation but no less critical. Examples are overhead and I/O functions. Additional services may be added as necessary to meet specific application requirements. If so, corresponding subparagraphs must be added below. Do not reuse paragraphs for support services that are not applicable.)

3.2.1.2.1.1 Executive Control. The executive control support service shall provide operational control for the Flight Station segment. This control shall include execution sequencing of all software, mode and state control, and communication between the simulation software and the VNET.

(For most applications, this paragraph will require no tailoring. If additional or specific executive control functions are required, they should be identified in this paragraph.)

3.2.1.2.1.2 Initialization. The initialization support service shall control initial hardware and software states for the Flight Station segment. System initialization shall occur during power-up and system resets, as defined in Volume I of this specification. The initialization function shall also access

mission initialization data, and transfer the data to other segment functions for mission initialization.

(Initialization requirements unique to the application aircraft Flight Station segment should be specified in this paragraph. Initialization refers to setting initial hardware and software states during power-up and system resets as defined in Volume I. Instrument scale factors and default instrument settings (usually powered off) are typically initialized by this function. A second initialization function is to access mission initialization data (from disc for example) to pass to other segment functions for mission initialization.)

3.2.1.2.1.2.1 Electrical System Function Initial Conditions. The application aircraft electrical system shall be initialized to a "power off" state. Power conditions with respect to battery power or external power shall reflect the state of the flight station demanded control positions.

(Initial conditions for the electrical system, as determined by training mission requirements, should be identified in this paragraph.)

3.2.1.2.1.2.2 Hydraulic System Function Initial Conditions. The application aircraft hydraulic systems shall be initialized to a state indicative of a fully serviced aircraft.

(Initial conditions for the hydraulic system, as determined by training mission requirements, should be identified in this paragraph.)

3.2.1.2.1.2.3 Fuel Management System Function Initial Conditions. The application aircraft shall be initialized to a state where all fuel tanks are filled to a nominal level. The aircraft CG shall be initialized to the value appropriate for the aircraft initial aircraft loading.

All ECS simulations shall be initialized to a stable state which is indicative of the initial state of the application aircraft in an on ground, powered off condition.

(Initial conditions for the Fuel Management system, as determined by training mission requirements, should be identified in this paragraph.)

3.2.1.2.1.2.4 Pneumatic System Function Initial Conditions. The application aircraft shall be initialized to a depressurized state with the exception of the pneumatic systems which shall be pressurized to the nominal service level for the application aircraft.

(Initial conditions for the pneumatic system, as determined by training mission requirements, should be identified in this paragraph.)

3.2.1.2.1.2.5 Autochecklist Function Initial Conditions. The autochecklist function shall initialize the application aircraft autochecklist systems to a powered off state.

(Initial conditions for the autochecklist function, as determined by training mission requirements, should be identified in this paragraph.)

3.2.1.2.1.2.6 Oxygen System Function Initial Conditions. The application aircraft oxygen system simulation shall be initialized to a state indicative of a fully serviced aircraft in a powered off state.

(Initial conditions for the Oxygen system, as determined by training mission requirements, should be identified in this paragraph. Identify this paragraph as "Not Applicable" if the oxygen system function is non-functional.)

3.2.1.2.1.2.7 Crew Station Interface Initial Conditions. All crew station controls and displays shall be initialized to the true state of the condition of the application aircraft.

(Initial conditions for the Crew Station Interface function, as determined by training mission requirements, should be identified in this paragraph. Some initialization tasks may require crew member interaction to locate switches and controls to the proper position. The initialization function should detect out of position switches and advise the IOS of current and desired/correct position. Typical initialization is all systems off, gear down, flaps up, etc., representative of a serviced aircraft for its next mission.)

3.2.1.2.1.3 MSS Virtual Network Communication. The MSS VNET communication support service shall provide the Flight Station segment interface to the MSS VNET. It shall allow communication with other segments in the _____*(insert application aircraft type)* MSS. The Flight Station segment shall communicate with the MSS VNET in accordance with the protocol requirements defined in the _____*(insert application aircraft type)* MSS IDD, _____*(insert MSS IDD Number)*.

3.2.1.2.1.4 Diagnostics and Test. The diagnostics and test support service shall provide control for the diagnostic and test functions incorporated into the Flight Station segment. Diagnostic and test requirements shall be in accordance with the requirements specified herein.

(Based upon the specific simulator diagnostic requirements, all, or part of the three types of diagnostic capabilities may be required. "Not Applicable" should be inserted if the specific diagnostic type is not required for the application MSS. Specific Diagnostics and their requirements should be listed in each paragraph when applicable.)

3.2.1.2.1.4.1 On-Line Diagnostics. On-line diagnostics shall be provided for the Flight Station segment. These diagnostics shall be self initiating during start-up and/or they may be executed as a background function during training mode.

(On-line diagnostics are those diagnostics that are executed while the training system is in the real-time training mode. These diagnostics may run as a background task. An example that would be used in an MSS environment might be a segment functional diagnostic. Each segment would tell the IOS segment that it was still functioning on a periodic basis (say once a minute). If the IOS does not receive the message, then it assumes the segment is not functioning properly and provides a message to the instructor.)

3.2.1.2.1.4.2 Off-Line Diagnostics. Off-line diagnostics shall be provided by the Flight Station segment. Off-line diagnostics shall be executed when the _____*(insert application aircraft type)* is not in a system mode.

(Off-line diagnostics are those diagnostics that are performed on a segment in the stand-alone or segment mode. Typical off-line diagnostics would include hardware self tests, software tests, I/O debug programs, Daily Readiness at a segment level, etc.)

3.2.1.2.1.4.3 Remote Controlled Diagnostics. Remote Controlled Diagnostics shall be provided for the Flight Station segment. These diagnostics shall be executable, from the Instructor Operator Station (IOS), when the MSS is in the Remote Controlled Diagnostic mode.

(Remote controlled diagnostics are those diagnostics that run in the special remote controlled diagnostic mode. These diagnostics require the system to be up and running and the segments communicating. An example of a remote controlled diagnostic would be a real-time debugger.)

3.2.1.2.1.5 Backdoor Interfacing. The backdoor interface support service shall provide the means to support external interfaces to the Flight Station segment. All ownship crew station controls and displays and ancillary devices I/O not specifically identified in the _____*(insert application aircraft type)* MSS IDD shall interface via the MSS VNET. Backdoor interfaces shall not be utilized for normal intersegment communication.

(Specific external interfaces should be identified in this paragraph. Backdoor interfaces may include a 1553 bus to communicate with installed aircraft avionics or a specialized interface to drive a Head Up Display (HUD). A backdoor interface may not be utilized to transmit intersegment data.).

3.2.1.2.1.6 Malfunctions. The malfunctions support service shall provide the control for the processing and execution of the Flight Station segment malfunctions. The system response shall be in accordance with the aircraft design criteria.

(The Flight Station segment malfunctions should be defined in a program unique Malfunction Description Document.)

3.2.1.2.1.7 Damage Assessment. The damage assessment support service shall provide for the processing and implementation of any damage simulation for which the Flight Station segment is

responsible. This shall include the degradation of the appropriate systems within the Flight Station segment based on the evaluation of the damage severity and location.

(Based upon the training requirements of the application aircraft MSS, any specific damage assessment and system degradation requirements should be identified in this paragraph.)

3.2.1.2.1.8 Security Processing. The Flight Station segment security processing support service shall provide for the processing of the security requirements of the _____*(insert application aircraft type)* MSS Flight Station segment.

(This paragraph should be expanded to clearly specify which government directives apply, and to what extent, consistent with security considerations. Security processing would include Memory Erase Mode if required and any other security considerations such as removable memory or special encoding devices.)

3.2.1.2.1.9 Scoring. The scoring support service shall provide the ability to collect specific data for the assessment of a student's performance in his utilization of the _____*(insert application aircraft type)* Flight Station system. The Flight Station segment scoring data shall be provided to the IOS segment via the MSS VNET.

(Application specific scoring data requirements to the Flight Station segment shall be listed in this paragraph. If large amounts of data are required, it may be advisable to provide this to the IOS as a non-realtime activity.)

3.2.1.2.1.10 Other Support Function Services. Not Applicable.

(If there are other support functions unique to this segment they should be listed here, otherwise identify this paragraph as "Not Applicable". Intrasegment communication is an example of a function that might be listed in this paragraph. Before defining new functions, be sure the function cannot be incorporated as a variant of an existing function.)

3.2.1.2.2 Electrical System Function. The electrical system function shall simulate the electrical power generation and distribution system in the application aircraft. The electrical system function begins at the prime power (engine) output shaft and ends at the equipment load (black box) power input. Power generation (AC and DC), storage (battery), distribution (AC and DC buses), and control (bus control logic and circuit breakers) shall be simulated. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The electrical system function shall incorporate an engineering model appropriate for the application aircraft electrical power generation and distribution system. This shall include modeling

of generators and power supplies, Alternating Current (AC) and Direct Current (DC) power busses, and circuit breaker arrays.

The function should respond to crew member inputs (circuit breaker and bus select switch positions), model the interconnect which would occur on the target vehicle, set bus power available variables for transmission segments, evaluate bus loads based on equipment status received over the MSS Virtual Network, execute bus overload protection, display bus status to the crew member, and implement malfunction response when malfunctions are inserted.

(This paragraph should describe the required functionality of the Electrical system simulation. Some tailoring of this paragraph may be required to identify the specific application aircraft requirements. The following items should be considered when specifying requirements for the Electrical system simulation:

a. DC bus distribution
b. AC bus distribution
c. Bus loads
d. Battery system outputs (voltage, current)
e. Generator modeling
f. External power availability
g. Circuit breaker requirements
h. Interior or exterior lighting requirements
i. Degraded system operation (Battle Damage, Malfunctions))

3.2.1.2.3 Hydraulic System Function. The hydraulic system function simulates the application aircraft hydraulic systems. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The hydraulic system function shall incorporate an engineering model appropriate for the application aircraft hydraulic power generation and distribution system. This shall include modeling of pumps and valves, and hydraulic supply systems. The function should respond to crew member inputs, model supply routing, provide available power variables to the MSS Virtual Network via the service function, receive system loads, compute system response, display status to crew member, and implement response to malfunctions inserted at the IOS.

(This paragraph should describe the required functionality of the Hydraulic system simulation. Some tailoring of this paragraph may be required to identify the specific application aircraft requirements. The following items should be considered when specifying requirements for the Hydraulic system simulation:

a. Hydraulic reservoir data

b. Number and types of hydraulic pumps
c. Hydraulic pressures
d. Actuator flows and bleeds
e. Degraded system operation)

3.2.1.2.4 Fuel Management System Function. The fuel management system function shall simulate the transfer of fuel throughout the application aircraft, including feed to the engines, tank to tank, fuel dump and fuel replenishing from sources external to the aircraft. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

This function will also simulate the application aircraft CG trim system and the heat transfer between the fuel and Environmental Control System (ECS) systems. The heat transfer and ECS simulation may be extended to other liquids including hydraulic oil, air to air, and air to liquid.

The fuel management system function shall incorporate an engineering model appropriate for the application aircraft fuel supply and distribution system. This shall include modeling of pumps and valves, fuel pressures and temperatures, transfer of fuel between fuel tanks and transfer of fuel from external sources.

The aircraft CG trim control simulation shall incorporate an engineering model appropriate for the application aircraft CG trim system. The aircraft CG trim control simulation shall generate fuel movement commands and cargo movement commands to simulate distribution of weight for CG management.

The fuel/ECS heat transfer simulation shall incorporate an engineering model appropriate for the application aircraft. The fuel/ECS heat transfer simulation shall model heat exchangers for the fuel, hydraulic, pneumatic, and cockpit environmental systems.

The fuel management system function shall model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the application aircraft equipment simulated by this function.

(Additional subfunctions must have performance requirements defined in this paragraph. CG trim control and fuel/ECS heat transfer are examples of fuel management subfunctions. Others may be included as necessary to support the application vehicle. Electrical (hydraulic, pneumatic) loads due to operation of the fuel management system (i.e., valve control power and pump power loads) are computed by the fuel management function and passed back to the electrical (hydraulic, pneumatic) system function for total load management. Some tailoring of this paragraph may be required to identify the specific application aircraft requirements. The

following items should be considered when specifying requirements for the Fuel Management system simulation:

a. Fuel tank quantity data
b. Fuel flow distribution data
c. Fuel valve modeling
d. Fuel pump modeling
e. Target CG trim control
f. Aerial refueling and/or fuel dump capability
g. Fuel moments
h. Fuel tank temperatures
i. Fuel transfer logic
j. APU fuel flow requirements
k. Fuel/ECS heat transfer
l. Degraded system operation)

3.2.1.2.5 Pneumatic System Function. The pneumatic system function shall simulate the cabin air conditioning and cabin pressurization systems in the application aircraft. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The pneumatic system function shall incorporate an engineering model appropriate for the application aircraft pneumatic, air conditioning and pressurization systems. This function shall model valves, supply and distribution systems for the aircraft pneumatic, air conditioning and pressurization systems. Cabin environmental status, pressures and temperatures shall be provided to the support function for output on the MSS global bus. Inputs are received from the Crew Station Interfaces and computed outputs are passed to the Crew Station Interface for display.

The pneumatic system function shall model electrical current demand and hydraulic pressure demand for the application aircraft equipment simulated by this function.

(Some application aircraft may use pneumatics as a power source. In those cases, the subfunction should be identified here and described in detail in subparagraphs as appropriate. Any additional subfunctions must have performance requirements defined in this paragraph. The following items should be considered when specifying requirements for the Pneumatic system simulation:

a. Engine bleed air flow demands
b. Cabin pressurization requirements
c. Pneumatically controlled flight controls
d. Duct and cabin temperatures

e. Degraded system operation)

3.2.1.2.6 Autochecklist Function. The autochecklist function simulates the automatic monitoring system of the application aircraft. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The autochecklist function shall incorporate an engineering model appropriate for the application aircraft automated status monitoring system. This model shall monitor aircraft system variables and shall be capable of triggering emergency and abnormal condition procedures upon detection of equipment failure or malfunction.

The autochecklist function shall model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the application aircraft equipment simulated by this function.

(Examples of aircraft automatic monitoring systems are Malfunction Detection and Reporting system (MADAR, C-5A) and Central Integrated Test System (CITS, B-1B). A description of application specific automatic monitoring systems should be identified here and described in detail in subparagraphs.)

3.2.1.2.7 Oxygen System Function. The oxygen system function shall model the crew air supply equipment onboard the application aircraft. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The oxygen system function shall incorporate an engineering model appropriate for the application aircraft crew air supply system. The oxygen system function shall calculate quantity and pressure of the oxygen supply.

(Frequently this system is nonfunctional in a mission simulator. If so, identify this paragraph as "Not Applicable". Otherwise describe application specific details in this paragraph.)

3.2.1.2.8 Crew Station Interface Function. The crew station interface function shall provide the interface to various simulated and actual aircraft equipment. This function shall provide a centralized interface for multi-purpose equipment and all equipment which is not time critical. It shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The crew station interface function shall provide data unit conversion from the engineering representation as presented on

the MSS Virtual Network to the electrical units required for stimulation of cockpit instruments and controls. This function shall provide the interface to aircraft specific equipment. This function converts engineering units (feet, feet per second, Mach, etc.) to output units (volts, on/off, etc.) which is then converted in D/A circuits to drive displays. Likewise inputs (volts, on/off, etc.) are converted to engineering units (feet, feet per second, true/false, etc.) to be processed by other functions and/or segments.

(Representative equipment supported by this function include: cockpit indicators and controls, Multi-Function Displays (MFDs), avionics and aural warning systems.). Quantitative requirements for conversion accuracy, precision, and repeatability should be listed here. Some tailoring of this paragraph may be required to identify the specific application aircraft requirements. The following items should be considered when specifying requirements for the Crew Station Interface simulation:

a. Special interfaces for crew compartment controls and displays (1553 Bus, RS-232, etc.)
b. Analog input data requirements (Propulsion, Navigation, Flight Controls, Weapons, and Flight Dynamics analog input conversion to engineering units)
c. Discrete input requirements (Propulsion, Navigation, Flight Controls, Weapons, and Flight Dynamics state flags)
d. Serial input data requirements (conversion of serial input data to engineering units)
e. Analog output data requirements (Electrical, Hydraulic, Fuel Management, Pneumatic, Autochecklist, Oxygen, Propulsion, Navigation, Flight Controls, Weapons and Flight Dynamics analog output conversion from engineering units to I/O units)
f. Discrete output requirements (Electrical, Hydraulic, Fuel Management, Pneumatic, Autochecklist, Oxygen, Propulsion, Navigation, Flight Controls, Weapons and Flight Dynamics I/O flags)
g. Serial output data requirements)

3.2.2 System Capability Relationships. The Flight Station segment shall support the system capability relationships defined in Volume I of this specification. Flight Station segment functional relationships shall be as described in the following paragraphs.

(Define any Flight Station segment unique capability relationships. In general, the capability relationships specified in Volume I will suffice for this segment.)

3.2.2.1 Segment Functional Relationships. The top level, typical Flight Station segment functional relationships are depicted in FIGURE 1. Each function shall operate in a manner which will allow the segment, as a system, to satisfy the timing requirements described in Volume I of this specification. Functions implemented within the Flight Station segment shall

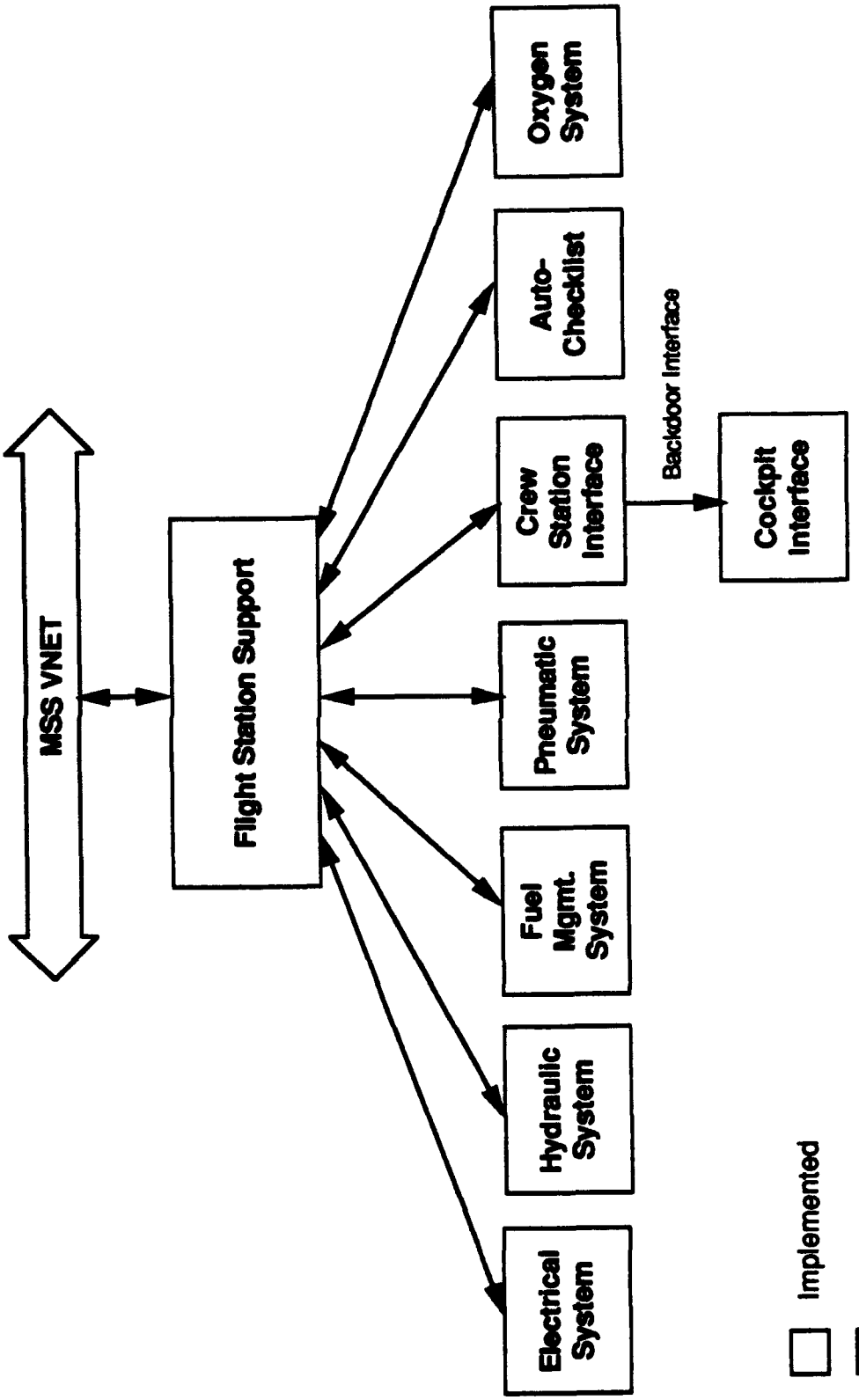

FIGURE 1 FLIGHT STATION SEGMENT FUNCTIONAL RELATIONSHIPS

operate in such a manner which will allow the segment to meet both segment and system level requirements without degradation.

(There are two approaches to describing intra-segment interfaces: all functions communicate through the support function, or all functions communicate directly with other functions. FIGURE 1 in all segments may have the same structure. For this segment, functions which are not implemented should be shaded out. If desired, functions which are only partially implemented may be graphically represented with cross hatching. Note that the intent of this diagram should be to identify "required" internal relationships and not to specify the segment's internal design. The tailoring of this paragraph should be done very carefully.)

3.2.3 External Interface Requirements. The Flight Station segment shall support the external interface requirements defined in Volume I of this specification and the _____*(insert application aircraft type)* MSS Interface Requirements Specification (IRS). External interfaces comprise of data passed between Flight Station segment functions and the functions of other MSS segments. With the exception of the dedicated interfaces for the cockpit, all other external interfaces which shall be used for the Flight Station segment are specified in the _____*(insert application aircraft type)* MSS IRS.

(Define any Flight Station unique external interface requirements. External facility interfaces for primary power, cooling, floor space, etc., should be identified here or specifically referenced in Volume I.)

3.2.4 Physical Characteristics. The physical characteristics of the Flight Station segment shall meet the requirements as specified in Volume I of this specification. The Flight Station segment physical characteristics shall be of such design as to interface with the other MSS segments via the MSS VNET.

(Physical characteristics requirements for the Flight Station segment other than those provided by the Flight Station segment computational system and its interface to the MSS Virtual Network shall be listed in this paragraph. Physical characteristic requirements may include backdoor interface hardware to connect Flight Station segment I/O to the Flight Station equipment in the application aircraft cockpit; in particular, backdoor hardware interfaces may be required for the control panels in the Flight Station cockpit. In addition, any weight or size considerations applicable to the weapons segment should be considered.)

3.2.4.1 Protective Coatings. Flight Station protective coatings shall be as defined in Volume I of this specification.

(Additional protective coating requirements which are required for the Flight Station segment may be defined in this paragraph. In general, the requirements of Volume I should suffice for the entire system)

3.2.5 Flight Station Segment Quality Factors

3.2.5.1 Reliability. The system level reliability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Flight Station segment reliability must be _____ % to satisfy the system level reliability requirements. The Mean Time Between Critical Failure (MTBCF) shall not be less than _____ hrs.

(A specific allocation of reliability (e.g. MTBF) for this segment should be specified in this paragraph. Reliability should be allocated to each segment in such a way that system level reliability requirements will be met. Normally, this means that segment reliability will be higher than system reliability.)

3.2.5.2 Maintainability. The system level maintainability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Flight Station segment shall have a mean corrective maintenance time of _____ minutes, and a 90th percentile maximum corrective maintenance time of _____ minutes to satisfy the system level maintainability requirements.

(Maintainability requirements such as Mean Time to Repair (MTTR) should be allocated to each segment in such a way that system level maintainability requirements will be met. Normally, this means that segment MTTR will be higher than system MTTR. System Level requirements will include isolation to a faulty segment.)

3.2.5.3 Availability. The system level availability requirements applicable to all segments in the MSS shall be as defined in Volume I of this specification.

(Usually, availability applies only to the system level. Reliability and Maintainability (MTBF and MTTR) are allocated to each segment in such a way that system availability requirements will be met. It would be unusual to impose an availability requirement at the segment level.)

3.2.5.4 Additional Quality Factors. The additional quality factors, as defined in Volume I of this specification, shall apply to Flight Station segment.

(Additional Flight Station segment unique quality factors may be defined in this paragraph. In general, the system level additional quality factors will suffice for the Flight Station segment.)

3.2.6 Environmental Conditions. The environmental conditions requirements, as defined in Volume I of this specification, shall apply to Flight Station segment.

(Identify any Flight Station segment unique environmental requirements. In general, the system level environmental conditions will suffice for the Flight Station segment.)

3.2.7 Transportability. The transportability requirements, as defined in Volume I of this specification, shall apply to Flight Station segment.

(Identify any Flight Station segment unique transportation requirements. There may exist unique transportation requirements to ship the segment from the segment contractors facility to the prime contractors facility. In general, the system level transportability requirements will suffice for the flight Station segment.)

3.2.8 Flexibility and Expansion. The flexibility and expansion requirements, defined in Volume I of this specification, shall apply to Flight Station segment.

(Unique requirements for this segment may include spare memory, spare time, spare mass storage, I/O channels by type, chassis expansion slots, etc. Expansion requirements should consider the likelihood this segment will need to change as well as the cost of including capability now versus cost to change later. Reuse of the segment in future applications should also be considered and specified.)

3.2.9 Portability. The portability requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Except for field transportable trainers, portability of hardware is usually not a requirement. Portability of software may be a concern for future changes which may include upgrading the Computer Hardware Configuration Item (HWCI) are considered likely. Use of a standard higher order language such as Ada is usually adequate to assure software portability.)

3.3 Design and Construction. The design and construction requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique design and construction requirements. In general, the system level design and construction requirements will suffice for the Flight Station segment.)

3.3.1 Materials. The materials requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique materials requirements. In general, the system level materials requirements will suffice for the Flight Station segment.)

3.3.1.1 Toxic Materials. The toxic materials requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique toxic materials requirements. In general, the system level toxic materials requirements will suffice for the Flight Station segment.)

3.3.2 Electromagnetic Radiation. The electromagnetic radiation requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique electromagnetic radiation requirements. In general, the system level electromagnetic radiation requirements will suffice for the Flight Station segment.)

3.3.3 Nameplates and Product Marking. The nameplate and product marking requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique nameplate and product marking requirements. In general, the system level nameplate and product marking requirements will suffice for the Flight Station segment.)

3.3.4 Workmanship. The workmanship requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique workmanship requirements. In general, the system level workmanship requirements will suffice for the Flight Station segment.)

3.3.5 Interchangeability. The interchangeability requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique interchangeability requirements. In general, the system level interchangeability requirements will suffice for the Flight Station segment.)

3.3.6 Safety. The safety requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique safety requirements. In general, the system level safety requirements will suffice for the Flight Station segment.)

3.3.7 Human Engineering. The human engineering requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique human engineering requirements. In general, the system level human engineering requirements will suffice for the Flight Station segment.)

3.3.8 Nuclear Control. The nuclear control requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique nuclear control requirements. In general, the system level nuclear control requirements will suffice for the Flight Station segment.)

3.3.9 System Security. The system security requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique system security requirements. In general, the system level system security requirements will suffice for the Flight Station segment.)

3.3.10 Government Furnished Property. Government Furnished Property (GFP) shall be as identified in Volume I of this specification.

(Identify any Flight Station segment unique GFP requirements. In general, the system level GFP requirements will suffice for the Flight Station segment.)

3.3.11 Computer Resource Reserve Capacity. The system level reserve capacity requirements applicable to all segments in the MSS are defined in Volume I of this specification.

(In addition to the computer resources identified in Volume I, the specific reserve capacity for the Flight Station segment may include the computational system hardware and software required to design, develop, and test the Flight Station segment. System considerations such as spare (time, memory, storage, I/O channels) for growth unique to this segment should be imposed here. If this paragraph requires subparagraphs they should follow the numbering and topics used in Volume I.)

3.4 Documentation. The documentation requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique documentation requirements. Documentation requirements for the Flight Station segment may include interface specifications and design data for interfacing to an embedded piece of cockpit equipment. In general, the system level documentation requirements will suffice for the Flight Station segment.)

3.5 Logistics. The system level logistics requirements for the Flight Station segment shall be as specified in Volume I of this specification, paragraph 3.5, and all subparagraphs of paragraph 3.5.

(Unique support requirements for this segment should be described here. These may include special tools and jigs for installation, alignment and calibration; special environmental conditions for operation and repair such as a clean-room for component repairs; levels and types of spares required.)

3.6 Personnel and Training. The system level personnel and training requirements, defined in Volume I of this specification, shall apply to the Flight Station segment.

(Identify any Flight Station segment unique personnel and training requirements. In general, the system level personnel and training requirements (number, skills and training for maintenance personnel) will suffice for the Flight Station segment.)

3.7 Subordinate Element Characteristics. Not Applicable.

(This volume defines requirements for a subordinate element of the MSS. In general, there will be no subordinate elements of a segment.)

3.8 Precedence. The precedence requirements for the Flight Station segment shall be as specified in Volume I of this specification.

4. QUALIFICATION REQUIREMENTS

4.1 Responsibility For Test and Inspection. The _____*(insert application aircraft type)* MSS Responsibility For Test and Inspection requirements are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Flight Station segment.

(This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Flight Station segment.)

4.2 Special Tests and Examinations. The system level general qualification events, levels, and methods of testing for the Flight Station segment are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Flight Station segment.

(Clearly identify which test events defined in Volume I apply to this segment. Be particularly explicit about the segment builder's responsibility during system integration and test. In some cases, verification can only be achieved in the integrated mode. A clear definition of the segment supplier's responsibility during systems integration should be contained in the SOW.)

4.3 Requirements Cross Reference. A requirements compliance cross reference matrix shall be developed to ensure requirement traceability. The requirements cross reference matrix shall be included as part of the _____*(insert application aircraft type)* MSS Prime Item Development Specification (PIDS).

5. PREPARATION FOR DELIVERY

The _____*(insert application aircraft type)* MSS preparation for delivery requirements, as defined in Volume I of this specification, shall apply to Flight Station segment.

(Segment unique requirements may include packaging the segment for shipment to the integration location which could be different than packaging the system for shipment to the installation site. If requirements are imposed here, there may be test requirements for verification which must be added to Section 4.)

6. NOTES

6.1 Intended Use. The _____*(insert application aircraft type)* MSS shall be used as an integral part of the _____*(insert application aircraft type)* aircraft training system.

6.1.1 Missions. The Flight Station segment shall support the mission requirements described in paragraph 6.1.1 of Volume I of this specification. The Flight Station segment shall provide simulation and training in cockpit familiarization, Flight Station operating procedures, and mission procedures for the _____*(insert application aircraft type)* aircraft Flight Station systems. The Flight Station simulation shall provide familiarization with the cockpit configuration and operation of the _____*(insert application aircraft type)* Flight Station ancillary systems. The simulation shall provide an environment to gain proficiency in executing normal procedures, recognizing malfunctions/abnormal indications and executing the corresponding emergency procedures, and in executing mission procedures. The trainees may range in experience from newly designated aviators undergoing initial training to experienced aviators undergoing refresher training.

(The Flight Station mission is to support the trainer mission as described in Volume I. Any mission specific information should be described in this section. An example would be a segment intended to support a family of trainers such as a procedure trainer, part task trainer, flight trainer, and/or weapons system trainer.)

6.1.2 Threat. Not applicable.

(This paragraph shall describe the threat which the system is intended to neutralize. In this context, this paragraph is not applicable to most simulators, and will generally remain "Not Applicable".)

6.2 Flight Station Segment Acronyms. The acronyms contained in this paragraph are unique to the Flight Station segment and are in addition to the MSS acronyms contained in Volume I of this specification.

AC	Alternating Current
CITS	Central Integrated Test System
CG	Center of Gravity
CRT	Cathode Ray Tube
DC	Direct Current
DOD	Department of Defense
ECS	Environmental Control System
GFP	Government Furnished Property

H/W	Hardware
HUD	Head Up Display
IDD	Interface Design Document
I/O	Input/Output
IOS	Instructor Operator Station
IRS	Interface Requirements Specification
MADAR	Malfunction Detection and Reporting system
MDD	Malfunction Description Document
MFD	Multi-Function Display
MSS	Modular Simulator System
MTBCF	Mean Time Between Critical Failure
PIDS	Prime Item Development Specification
T.O.s	Technical Orders
VNET	Virtual Network

6.3 Glossary of Flight Station Segment Terms. The terms contained in this paragraph are unique to the Flight Station segment and are in addition to the MSS terms contained in Volume I of this specification.

AERIAL REFUELING - An aircraft configuration and operating mode that allows the air vehicle to receive inflight fuel on/off-loads from a tanker aircraft.

ANCILLARY SYSTEMS - The systems of an air vehicle which function in a supporting capacity to the more prolific systems such as flight dynamics and propulsion.

AUTOCHECKLIST FUNCTION - A system which monitors aircraft system variables and triggers emergency and abnormal condition procedures upon detection of equipment failure or malfunction.

CREW STATION - The area of the vehicle in which the operator(s) reside.

CREW STATION INTERFACE FUNCTION - The function which provides the interface to various simulated and actual aircraft equipment.

ELECTRICAL SYSTEM - A system which is comprised of the electrical components of a vehicle. In the simulation environment, this would include modeling the characteristics of the batteries, generators, power supplies, AC busses, DC busses, and circuit breakers.

FUEL MANAGEMENT SYSTEM - A system which is comprised of the fuel components of vehicle. In the simulation environment,

this would include modeling the characteristics of the fuel feed to the engines, fuel transfer, fuel dump, and fuel quantities.

HYDRAULIC SYSTEM - A system which is comprised of the hydraulic components of a vehicle. In the simulation environment, this would include modeling the pumps, valves, and characteristics such as bleeds, flows, and quantities.

INPUT/OUTPUT HARDWARE DEVICE - The interface electronics which senses crew station control inputs and drives crew station indicators.

INSTRUCTOR/OPERATOR STATION - Provides the central point of control for the entire air vehicle trainer. The primary user of the IOS is the training instructor.

MULTI-FUNCTION DISPLAY (MFD) - MFDs are Cathode Ray Tube (CRT) type display units which are used in performing weapon system management functions. The control function is provided through the use of option select buttons contained in a bezel around the display screen of each MFD. These buttons interact with the text displayed immediately adjacent to them to control whatever functions are displayed.

OXYGEN SYSTEM - A system which is comprised of the oxygen components of a vehicle. In the simulation environment, this would include the modeling of the onboard crew air supply equipment.

PNEUMATIC SYSTEM - The system which is comprised of the pneumatic components of a vehicle. In the simulation environment, this would include modeling the cabin air conditioning and cabin pressurization characteristics.

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II-2	D										
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II-4	D										
II-5	D										
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REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
A	BMAC-STS-86-303-1 Total revision required to incorporate changes required by testing/validation efforts and Government comments.	90/01/11	Prepared By
		90/01/14	Checked By
		91/01/14	Dwg. Qual.
		90/01/14	Supervised By
		91/01/15	Approved By
B	CCP HSV-H91-008 Total revision required to incorporate changes resulting from addition of two new specifications and new functional allocation. Damage Assessment and Scoring were added to the module support function. The Atmosphere and Companion functions were deleted from the module.	91/06/26	Prepared By
		91/06/26	Checked By
		91/06/26	Dwg. Qual.
		91/06/27	Supervised By
		91/06/27	Approved By
C	CCP HSV-H91-008 Total revision required to incorporate Government comments on document.	91-09-26	Prepared By
		91-09-26	Checked By
		91/09/26	Dwg. Qual.
		91-09-26	Supervised By
		91-10-08	Approved By

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REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
D	CCP HSV-H91-017 This specification volume has been totally revised to: 1. Change the format to comply with DI-CMAN-80008A. 2. Incorporate the tailoring instructions into the body of the text. The incorporation of tailoring instructions into each specification volume has caused a change in the number of specification volumes from fourteen to thirteen. Prior to this change, all tailoring instructions were provided in Volume XIII and Volume XIV contained the Tactical and Natural Environment segment specification. The content of Volume XIII has been integrated into the other specification volumes. The change is summarized as follows: **Volume** — **IS** — **WAS** I through XII — Titles for these volumes are unchanged XIII — Environment — Tailoring Instructions XIV — "Deleted" — Tactical and Natural Environment	93-08-23 93-08-23 93-08-23 93-08-24	PREPARED CHECKED SUPERVISED APPROVED

EWH: 93-08-23 Lindbergh